

Related Applications

This is a file wrapper continuation application of our previously filed application Serial No. 09/264,577 filed March 8, 1999, which was a continuation-in-part of Serial No. 08/782,816, filed January 13, 1997, now U.S. Patent No. 5,958,106 issued September 28, 1999, which was a continuation-in-part of Serial No. 08/691,423, filed August 2, 1995, now U.S. Patent No. 5,779,761 issued July 14, 1998, which was a file wrapper continuation of Serial No. 08/283,358, filed August 1, 1994, now abandoned.

Background of the Invention

This invention relates to the production of elemental material from the halides thereof and has particular applicability to those metals and non-metals for which the reduction of the halide to the element is exothermic. Particular interest exists for titanium and the present invention will be described with particular reference to titanium, but is applicable to other metals and non-metals such as Al, As, Sb, Sn, Be, B, Ta, Ge, V, Nb, Mo, Ga, Ir, Os, U and Re, all of which produce significant heat upon reduction from the halide to the metal. For the purposes of this application, elemental materials include those metals and non-metals listed above or in Table 1.

At present titanium production is by reduction of titanium tetrachloride, which is made by chlorinating relatively high-grade titanium dioxide ore. Ores containing rutile can be physically concentrated to produce a satisfactory chlorination feed material; other sources of titanium dioxide, such as ilmenite, titaniferous iron ores and most other titanium source materials, require chemical beneficiation.

The reduction of titanium tetrachloride to metal has been attempted using a number of reducing agents including hydrogen, carbon, sodium, calcium, aluminum and magnesium. Both the magnesium and sodium reduction of titanium